

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT
AND DEPOT MAINTENANCE MANUAL
CRANE SHOVEL, BASIC UNIT, CRAWLER MOUNTED,
40 TON, 2 CU YD, DIESEL DRIVEN
(W/HARNISCHFEGGER ENGINE MODEL 687C-18-ES)
(W/CATERPILLAR ENGINE MODEL D333TA)
(HARNISCHFEGGER MODEL 855BG-2)
NON-WINTERIZED, FSN 3810-542-3048
WINTERIZED, FSN 3810-542-3049
(HARNISCHFEGGER MODEL 855BG-3)
NON-WINTERIZED, FSN 3810-786-5200

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1969

TECHNICAL MANUAL

No. 5-3810-201-35



HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 17 October 1969

**DIRECT AND GENERAL SUPPORT AND DEPOT
MAINTENANCE MANUAL**

**CRANE SHOVEL, BASIC UNIT, CRAWLER MOUNTED,
40 TON, 2 CU YD, DIESEL DRIVEN (W/HARNISCHFEGER ENGINE
MODEL 687C-18-ES) (W/CATERPILLAR ENGINE MODEL D333TA)
(HARNISCHFEGER MODEL 8555B-2)
NON-WINTERIZED, FSN 3810-542-3048
WINTERIZED, FSN 3810-542-3049
(HARNISCHFEGER MODEL 855-3)
NON-WINTERIZED, FSN 3810-786-5200**

			Paragraph	Page
Chapter	1.	INTRODUCTION		
Section	I.	General.....	1-1, 1-2	1-1
	II.	Description and data	1-3, 1-4	1-1
Chapter	2.	GENERAL MAINTENANCE INSTRUCTIONS		
Section	I.	Repair parts, special tools and equipment	2-1--2-3	2-1
	II.	Troubleshooting	2-4, 2-5	2-6
	III.	Removal and installation of major components or auxiliaries	2-6--2-10	2-8--2-11
Chapter	3.	ENGINE REPAIR INSTRUCTIONS		
Section	I.	Generator or alternator	3-1--3-3	3-1--3-5
	II.	Starter motor	3-4, 3-5	3-5
	III.	Power take-off unit and clutch	3-6, 3-7	3-7
	IV.	Engine governor.....	3-8--3-10	3-9--3-15
	V.	Fuel injector for engine model 687C-18-ES	3-11, 3-12	3-15
	VI.	Blower (supercharger) or turbocharger.....	3-13--3-15	3-16--3-26
	VII.	Fuel injection pumps	3-16--3-20	3-26--3-37
	VIII.	Cooling system	3-21--3-28	3-37--3-46
	IX.	Timing gear train	3-29--3-33	3-46--3-51
	X.	Valve operating mechanism.....	3-34--3-36	3-53--3-55
	XI.	Flywheel and housing	3-37--3-41	3-55--3-58
	XII.	Lubrication system	3-42--3-46	3-58--3-63
	XIII.	Engine front cover (model 687C-18-ES)	3-47-3-49	3-63-3-64
	XIV.	Camshaft	3-50-3-52	3-64-3-66
	XV.	Cylinder head, valve, block, and liners.....	3-53-3-55	3-66-3-73
	XVI.	Piston and connecting rod	3-56-3-58	3-73-3-76
	XVII.	Crankshaft and main bearings	3-59-3-61	3-76-3-78
	XVIII.	Engine crankcase	3-62--3-64	3-78-3-79
Chapter	4.	REVOLVING FRAME REPAIR INSTRUCTIONS		
Section	I.	Gantry and sheave yoke	4-1--4-3	4-1
	II.	Cab	4-4, 4-5,	4-2
	III.	Counterweight.....	4-6, 4-7	4-3
	IV.	Steering wheel and shaft.....	4-8, 4-9	4-3
	V.	Jackshaft (horizontal swing shaft)	4-10, 4-11	4-6
	VI.	Intermediate hoist shaft	4-12, 4-13	4-11
	VII.	Main drum (hoist) shaft	4-14, 4-15	4-12
	VIII.	Hoisting, digging, and auxiliary clutches.....	4-16-4-18	4-16
	IX.	Vertical intermediate idler shaft.....	4-19, 4-20	4-17
	X.	Vertical intermediate swing shaft	4-21, 4-22	4-19
	XI.	Swing brake and operating mechanism	4-23, 4-24	4-21

***This manual supersedes TM -5-3810-201-35, 12 August 1960, including C1, 10 July 1961.**

AGO 20051A

			Paragraph	Page
Section	XII.	Vertical swing shaft.....	4-25, 4-26	4-22--4-23
	XIII.	Vertical propelling shaft and pivot center gudgeon.....	4-27, 4-28	4-24
	XIV.	Boom hoist brake	4-29, 4-30	4-26
	XV.	Revolving frame and hook rollers	4-31--4-34	4-27--4-29
	XVI.	Hydraulic brake clutch cylinders	4-35--4-41	4-30--4-33
Chapter	5.	CRAWLER REPAIR INSTRUCTIONS		
Section	I.	Roller (turntable) circle	5-1, 5-2	5-1
	II.	Steering and propelling mechanism	5-3--5-6	5-1--5-4
	III.	Crawler drive shaft	5-7, 5-8	5-5
	IV.	Crawler idler sprocket and idler shaft	5-9--5-11	5-7--5-8
	V.	Horizontal propelling shaft	5-12, 5-13	5-9
	VI.	Crawler frame and tracks	5-14--5-16	5-11
Chapter	6.	REPAIR INSTRUCTIONS FOR MATERIEL USED IN CONJUNCTION WITH CRANE SHOVEL		
Section	I.	Shovel boom	6-1--6-5	---6-1--6-4
	II.	Shovel dipper and handle	6-6--6-9	6-5--6-7
APPENDIX	A.	REFERENCES		A-1
INDEX.....				Index 1

LIST OF ILLUSTRATIONS

Figure No	Title	Page
2-1	Specially designed (fabricated) tools (sheet 1 of 7)	2-1
2-1	Specially designed (fabricated) tools (sheet 2 of 7)	2-2
2-1	Specially designed (fabricated) tools (sheet 3 of 7)	2-2
2-1	Specially designed (fabricated) tools (sheet 4 of 7)	2-3
2-1	8Specially designed (fabricated) tools (sheet 5 of 7)	2-3
2-1	Specially designed (fabricated) tools (sheet 6 of 7)	2-4
2-1	Specially designed (fabricated) tools (sheet 7 of 7)	2-5
2-2	Cab removal points	2-8
2-3	Gantry, exploded view	2-9
2-4	Power take-off removal points	2-10
3-1	Generator, exploded view	3-2
3-2	Alternator, disassembly and reassembly	3-3
3-3	Starter motor, exploded view	3-6
3-4	Backplate, removal and installation	3-8
3-5	Power take-off and clutch, exploded view, (sheet 1 of 2)	3-9
3-5	Power take-off and clutch, exploded view, (sheet 2 of 2)	3-10
3-6	Overspeed governor, exploded view	3-11
3-7	Engine governor, right side, cross section view	3-12
3-8	Governor high or low idle speed adjustment	3-12
3-9	Fuel rack setting gage, installed on front end of fuel rack	3-13
3-10	Adjusting fuel rack setting	3-13
3-11	Governor, cross section view.....	3-14
3-12	Fuel injector, exploded view	3-15
3-13	Setting fuel injector nozzle tip angle with jig	3-16
3-14	Blowers, removal and installation	3-17
3-15	Blowers, exploded view (sheet 1 of 2)	3-18
3-15	Blowers, exploded view (sheet 2 of 2).....	3-19
3-16	Turbocharger, removal and installation	3-20
3-17	Turbocharger details (sheet 1 of 10)	3-20
3-17	Turbocharger details (sheet 2 of 10)	3-21
3-17	Turbocharger details (sheet 3 of 10).....	3-22
3-17	Turbocharger details (sheet 4 of 10)	3-23
3-17	Turbocharger details (sheet 6 of 10)	3-23
3-17	Turbocharger details (sheet 6 of 10)	3-23
3-17	Turbocharger details (sheet 7 of 10)	3-24
3-17	Turbocharger details (sheet 8 of 10)	3-24
3-17	Turbocharger details (sheet 9 of 10)	3-25
3-17	Turbocharger details (sheet 10 of 10)	3-26
3-18	Fuel injection pump and drive mechanism, removal and installation	3-27
3-19	Shut-off cam, removal and installation	3-28
3-20	Pump drive mechanism, exploded view.....	3-29
3-21	Fuel Injection pump, exploded view (sheet 1 of 2)	3-30
3-21	Fuel injection pump, exploded view (sheet 2 of 2)	3-31
3-22	End plate sleeve, removal points	3-32

Figure No	Title	Page
3-23	Transfer pump distributor rotor, removal	3-32
3-24	Fuel transfer pump, disassembly and reassembly	3-33
3-25	Fuel injection valve, removal, disassembly, reassembly, and installation	3-34
3-26	Fuel injection pumps, removal, disassembly, reassembly and Installation	3-35
3-27	Fuel injection pump housing and fuel pump, exploded view	3-36
3-28	Fuel injection pump lifter, camshaft, fuel rack and housing, exploded view	3-37
3-29	Radiator for engine model 687C-18-ES, exploded view.....	3-38
3-30	Radiator for engine model DS33TA, exploded view.....	3-39
3-31	Fan assembly for engine model 687C-18-ES, exploded view	3-40
3-32	Water pump for engine model 687C-18-ES, exploded view	3-41
3-33	Water pump for engine model D333TA, exploded view	3-42
3-34	Oil cooler cover and elbows, exploded view	3-43
3-35	Oil cooler core, hose, and elbow, exploded view	3-44
3-36	Aftercooler cover and thermostat housing, exploded view	3-45
3-37	Aftercooler core and related parts, exploded view	3-46
3-38	Blower drive and idler gear, exploded view	3-47
3-39	Timing gear train and drive gears, installed view --	3-48
3-40	Front cover, damper, pulley, and support, exploded view	3-50
3-41	Accessory drive, exploded view	3-51
3-42	Valve rocker arm, installed view	3-52
3-43	Rocker arm, pushrod, and cam lever, exploded view.....	3-53
3-44	Valves, pushrods, rocker arms, and shaft, exploded view	3-54
3-45	Flywheel housing and rear plate, exploded view	3-56
3-46	Flywheel and flywheel housing, exploded view	3-57
3-47	Oil pan, exploded view	3-58
3-48	Oil pan and plate, exploded view	3-59
3-49	Oil pump and crankshaft, installed view	3-60
3-50	Oil pump, for engine model 687C-18-ES, exploded view	3-60
3-51	Oil pump and screen for engine model D33TA with screen exploded	3-61
3-52	Oil pump, for engine model D333TA, exploded view	3-62
3-53	Front cover, support, and damper, exploded view	3-64
3-54	Camshaft for engine model 687-18-ES, exploded view	3-65
3-55	Camshaft for engine model D333TA, exploded view	3-66
3-56	Cylinder head, valve, and liner, removal	3-67
3-57	Cylinder head, valve, and liner, exploded view	3-67
3-58	Cylinder head and liner, disassembly and reassembly	3-68
3-59	Cylinder head and valves, exploded view	3-70
3-60	Cylinder block, cylinder sleeve, and main bearing caps, exploded view	3-71
3-61	Positioning the precombustion chamber, and sequence for cylinder head bolt tightening	3-72
3-62	Precumbustion chamber positioning diagram	3-73
3-63	Piston and connecting rod for engine model 687C-18-ES	3-74
3-64	Piston and connecting rod for engine model D333TA, exploded view	3-75
3-65	Crankshaft and flywheel for engine model 687-18-ES, exploded view	3-77
3-66	Crankshaft and main bearings for engine model D333TA, exploded view	3-78
3-67	Crankcase and exhaust manifold, exploded view	3-79
4-1	Gantry sheave yoke and adapters, exploded view.....	4-2
4-2	Steering wheel shaft and vertical propel gear, installed view	4-4
4-3	Steering wheel and shafts, exploded view	4-5
4-4	Main hoist shaft, right side installed view	4-6
4-5	Main hoist shaft, left side installed view	4-7
4-6	Jackshaft (horizontal swing shaft) installed view	4-8
4-7	Horizontal swing shaft (jackshaft) exploded view	4-9
4-8	Intermediate hoist shaft, exploded view	4-11
4-9	Main drum (hoist) shaft, exploded view (sheet 1 of 2).....	4-13
4-9	Main drum (hoist) shaft, exploded view (sheet 2 of 2)	4-14
4-10	Hoisting, digging, and auxiliary clutches, exploded view	4-17
4-11	Vertical swing shaft and intermediate idler shaft, installed view	4-18
4-12	Vertical intermediate idler shaft, exploded view -	4-19
4-13	Intermediate swing shaft, removal	4-19
4-14	Vertical intermediate swing shaft, exploded view.....	4-20
4-15	Swing brake band and linkage, exploded view	4-22
4-16	Vertical swing shaft, exploded view	4-23
4-17	Vertical propelling shaft and pivot center gudgeon, exploded view	4-25
4-18	Boom hoist brake, exploded view	4-26
4-19	Front and rear hook rollers, exploded view	4-28
4-20	Revolving frame, exploded view	4-29
4-21	Hydraulic brake cylinder, exploded view	4-30

Figure No	Title	Page
4-22	Planetary, hoist, digging, and boom brake hydraulic cylinder, exploded view	4-31
4-23	Clutch boom hoist, swing, hoist, and digging brake compensators, exploded view	4-31
4-24	Jackshaft and brakedrum hydraulic cylinder, exploded view	4-32
4-25	Propel brake and planetary boom hydraulic compensator, exploded view	4-33
4-26	Pressure control valve, exploded view	4-34
5-1	Roller circle, exploded view	5-1
5-2	Steering and brake level shaft, removal and installation	5-2
5-3	Steering and brake level shaft, exploded view	5-3
5-4	Propelling brake and levers, exploded view	5-4
5-5	Crawler drive shaft, exploded view	5-5
5-6	Crawler frame, exploded view	5-6
5-7	Crawler idler sprocket and idler shaft, exploded view	5-8
5-8	Horizontal propelling shaft, installed view	5-9
5-9	Horizontal propelling shaft, installed view	5-10
5-10	Crawler track, disassembly and reassembly	5-12
6-1	Shipper shaft and saddle blocks, exploded view	6-1
6-2	Bridle bar and boom point sheaves, exploded view	6-3
6-3	Crowd and retract mechanism, exploded view	6-4
6-4	Chain tightener, exploded view	6-5
6-5	Shovel dipper and bail, exploded viewer	6-6
6-6	Dipper handle, exploded view.....	6-7

AGO 20051A

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for the use of direct support, general support and depot maintenance personnel maintaining the crane-shovel basic units, models 855BG-2 non-winterized, 855BG-2 winterized, and 855BG-3 nonwinterized, as allocated by the Maintenance Allocation Chart. It provides information on maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to organizational maintenance.

b. Report all equipment improvement recommendations as prescribed by TM 38-750.

a. DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to the Command General, U. S. Army Mobility Equipment Command, ATTN: AMSME MPP, 4300 Goodfellow Boulevard, St. Louis, Mo., 63120.

1-2. Forms and Records

Section II. DESCRIPTION AND DATA

1-3. Description

A general description of the crane-shovel basic unit and information pertaining to the identification plates are contained in TM 5-3810-201-12. A more detailed description of specific components and assemblies are contained in the applicable chapters of this manual.

Cooling Liquid cooled
Rotation at flywheel end Counterclockwise
Exhaust spring length with..... 2 3/8 + 1/32 -0
valve in closed position.
Exhaust spring load with..... 105 lb (pound) (s)
valve in closed position.

(2) *Engine classification and rating (model D33STA).*

1-4 Tabulated Data

a. *General.* This paragraph contains all maintenance data pertinent to direct support, general support and depot maintenance personnel. The wiring diagram is located in TM 5-3810-210-12.

ManufacturerCaterpillar
Model.....D333TA
Cycle4
Bore4.5 in.
Stroke4.5 in.
Total displacement522 cu in.
Horsepower (hp).....190 HP (without fan)
Number of cylinders6
Firing order-1-5-3-6-2-4
CoolingLiquid cooled
Rotation at flywheel end Counterclockwise
Full load rpm.....2,000
High idle rpm2,180
Low idle rpm600

b. *Engine Classification and Rating.*

(1) *Engine classification and rating (model 687C-18-ES).*

Manufacturer.....Harnischfeger
Model.....687C-18-ES
Cycle.....2
Bore4.5 in. (inch) (es)
Stroke5.5 in.
Total displacement.....522 cu in. (cubic inches)
Horsepower190 at 1,700 rpm (revolutions
per minute)
Compression ratio.....16 to 1
Number cylinders6
Firing order1-6-2-4-3-5

c. *Generator and Alternator Specifications*

(1) *Generator specifications (for engine model 687C-18-ES).*

ManufacturerDelco-Remy
Model.....1117478

AGO 20051A

Amperes 40 at 4,000 rpm
 Voltage..... 28 at 4,000 rpm
 Rated volts..... 24
 Number of brushes 4
 New brush length 15/16 in.
 Worn brush length 15/32 in.
 Spring tension..... 28 oz (ounce) (s)
 Commutator rotation Clockwise

(2) *Alternator specifications (for engine model D333TA).*

Manufacturer..... Delco-Remy
 Model 1117072
 Brush spring tension 10 oz
 Rotation (viewing drive end) clockwise
 Circuit..... A or B (normally B)
 Field current (80° F.)
 Volts 24 vdc
 Amp 3.6 to 4.0
 Output (cold):
 Volts 24 vdc
 Amp 61
 Approximate RPM..... 2,500

d. Generator and Alternator Regulator Specifications.

(1) *Generator regulator specifications (for engine model 687C-18-ES)*

Manufacturer..... Delco-Remy
 Model 1118558
 Volt..... 24
 Amperes 40
 Circuit- B
 Type..... Fungus and corrosion
 Ground polarity Negative
 Voltage regulator:
 Air gap 0.084 in.
 Operating range 27.5-29.5 v
 Current regulator:
 Air gap 0.115 in.
 Operating range 38-42 amp
 Cutout relay:
 Air gap 0.048 in.
 Point opening 0.035 in.
 Closing range- 25-27 v

(2) *Alternator regulator specifications (for engine model D333TA).*

Manufacturer..... Delco-Remy
 Model 9000591
 Circuit..... A or B (normally B)
 Polarity..... Either
 (A circuit for positive
 ground B circuit for
 negative ground)
 Voltage setting range 27.5 to 28.5 VDC (with
 adjusting screw at zero)

e. Starter Motor Specifications.

(1) *For engine model 687C-18-FS.*

Manufacturer..... Delco-Remy
 Model 1113757
 Rotation Clockwise at drive end
 Volts..... 24 vdc
 Maximum amperes- 100 at 8,000 rpm

Minimum torque..... 28 ft lb
 Mica undercut 1/32--3/64in.

(2) *For engine model D333TA.*

Manufacturer Delco-Remy
 Model..... 1113771 or 1113818
 Volts. 24 VDC
 Rotation Clockwise at drive end
 No load test
 Volts 23.0
 Maximum amperes..... 82.5 for model 1113771
 90 for model 1113818
 Minimum RPM 7,000
 Lock test
 Volts 3.5
 Maximum amp 500
 Minimum torque 26 ft lb
 Minimum brush
 Spring tension 80 oz

f. Specific Torque Values.

(1) *Engine model 687C-18-ES.*

Flywheel capscrew 100 ft lb
 Main bearing cap 120 ft lb
 Head nut..... 100 ft lb
 Connecting rod nuts 50 ft lb
 Pump cam advance screw 30 ft lb
 Injector securing nut 15-20 ft lb
 Cam lever and support 15-20 ft lb
 assembly securing nut.
 Injection pump drive shaft nut. 80 ft lb
 Camshaft nut 100 ft lb
 Exhaust manifold nut 50 ft lb
 Crankshaft gear bolt 20-25 ft lb
 Flywheel housing capscrew..... 45 ft lb
 Cam pocket cover capscrew- 15-20 ft lb
 Main bearing stud- 100-125 ft lb
 Cylinder head stud 50-100 ft lb
 Idler gear bolt 30-35 ft lb
 Rocker arm support bolt 60 ft lb
 Injector stud 15 ft lb
 End plate capscrew 45 ft lb
 Rocker arm support nut 70 ft lb

(2) *Engine model D333TA.*

Accessory drive idler gear 190-210 ft lb
 Alternator pulley retaining nut. 60 ft lb
 Camshaft retaining nut 190-210 ft lb
 Connecting rod bolt 85 ft lb
 Crankshaft main bearing nut 155 ft lb
 Crankshaft pulley retaining bolt. 210-250 ft lb
 Cylinder head (initial) 105 ft lb
 Cylinder head (final) 155-165 ft lb
 Flywheel retaining bolt..... 130-170 ft lb
 Flywheel housing bolt 65-86 ft lb
 Injection pump retaining 140-160 ft lb
 bushing.
 Injection nozzle retaining nut 100-110 ft lb
 Fuel line nut 25-35 ft lb
 Oil pump drive gear retaining nut. 60 ft lb
 Pre-combustion chamber- 140-160 ft lb
 Glow plug..... 8-12 ft lb
 Rocker arm cover bolt 12-18 ft lb
 Rocker arm shaft retaining bolt. 95-125 ft lb
 Timing gear housing bolt 27-37 ft lb

Turbocharger compressor 120 in. lb
cover and turbine housing
band clamp bolts.
Turbocharger to manifold 36-44 ft lb
bolts (using antifreeze
compound).
Vibration dampener bolt.....65-85 ft lb
Water pump impeller retain 50-55 ft lb
ing nut.

g. Adjustment Data.

(1) Engine model 687C-18-ES.

	Allowable tolerances	Limits
Transfer pump pressure at 1,800 rpm.	110 to 120 lb	80 lb
Injector pop pressure in psi (pounds per square inch).	2,200 to 2,250 psi	2,000 psi
Compression pressure cranking speed at 150-200 rpm -maximum variations of 30 psi between any two cylinders on engine.	325 to 400 psi	250 psi
Injection pump timing drive	26° BTC +1° (before top center)	
Pump timing	16 BTC -1°	
Lift at push rod	0.008 at 86 ½° ATC (after top center)	
Lift at exhaust valve	0.012 at 86 ½ ° ATC	
Oil pressure at 1,800 rpm	.52 to 80 psi	40 psi
Oil pump capacity	44 gpm	
Oil pump speed---	2,743 rpm	
Oil pump premier relief valve setting.	65 psi	
Fan speed	2,300 rpm	
Water flow	90 to 120 gpm (dependent on ambient temperature)	

Allowable tolerances Limits
Blower speed (ratio)-3.65 to 1
Water pump peed (ratio)3.65 to 1
Air box pressure at 1,8006.4 to 7.8 psi

(2) Engine model DS33TA.

Alternator belt tension @ 25 Will depress ½ in.
lb pressure.
Fan belt tension @ 25 lb Will depress ½ in.
pressure.
Fuel injection pump timing 11°
(BTC).
Fuel injection pump timing dimensions:
Off engine.....4.2675 ± .002 in.
On engine.....4.2255 ± .002 in.
Turbocharger, clearance be 018-.022 in.
tween Impeller and bearing housing.
Valve clearance:
Exhaust (hot)025 in.
Exhaust (cold)028 in.
Inlet (hot)015 in.
Inlet (cold)017 in.

h. Fuel Injection Pump Torque Data (Engine Model 687C-18-ES).

Transfer pump rotor 70-75 in. lb
Drive hub screw 400-500 in. lb
Drive sprocket 95 in. lb
End plate screws.- 36-39 in. lb

i. Repair and Replacement Standards. Table 1-1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearances for engine model D333TA. Table 1-2 lists standards for engine model 687C-18-ES.

Table 1-1. Engine Repair and Replacement Standards
For Engine Model D333TA

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear or clearances
	Min	Max	Min	Max	
Accessory Drive :					
Backlash between accessory drive and accessory drive idler gear	0.002	0.014			
Backlash between accessory drive idler gear and camshaft gear.....	0.002	0.014			
Idler gear and clearance	0.002	0.009	-----	-----	0.014
Idler gear bearing base.....	1.000	1.003			
Idler gear bearing clearance	0.001	0.005	-----	-----	0.007
Alternator:					
Belt tension (slack at point) midway between pulleys @ 25 lb	-----	0.500 in.			
Camshaft					
Backlash between cam-shaft gear and crank-shaft gear	0.001	0.013			
Bearing journal diameter	2.8105	2.3115			
Bearing clearance.....	0.0025	0.0055	-----	-----	0.007
End clearance.....	0.004	0.010	-----	-----	0.017

AGO 20051A

*Table 1-1. Engine Repair and Replacement Standards
For Engine Model D333TA--Continued*

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear or clearances
	Min	Max	Min	Max	
Connecting Rod:					
Bearing clearance.....	0.0032	0.0061	-----	-----	0.009
Center to center distance	8.999	9.001			
Piston pin bearing base	1.7009	1.7015			
Crankshaft:					
Main journal diameter	3.499	3.500	-----	-----	0.005
Main bearing clearance	0.0030	0.0059	-----	-----	0.008
End clearance.....	0.011	0.018	-----	-----	0.027
Connecting rod journal diameter--	2.999	3.000	-----	-----	0.004
Permissible out-of-round	-----	-----	-----	-----	0.002
Cylinder Block:					
Main bearing original base	3.8155	3.8165			
Cylinder Liner:					
Inside diameter	4.500	4.501			
Counterbore in block	0.400	0.402			
Flange thickness.....	0.403	0.405			
Fan Belt Tension:					
Slack at point midway between pulleys	-----	0.500 in.			
Fuel Injection Equipment:					
Fuel injection pump timing (before top center)	-----	11°			
Fuel Injection pump timing dimension setting (off engine)	-----	4.2675	0.002		
Fuel injection pump timing dimension setting (on engine) with pistons at top center	-----	4.2255	0.002		
Fuel pump plunger length	2.591	2.5937	-----	-----	0.004
Injector nozzle orifice	-----	0.025			
Fuel rack:					
Bearing bore	0.5007	0.5018			
Bearing clearance.....	0.002	0.008	-----	-----	0.004
Camshaft:					
Bearingbore	1.8750	1.8760			
Bearing clearance	0.0015	0.0035	-----	-----	0.007
Fuel Transfer Pump:					
Clearance between gears and covers total	0.0010	0.0022	-----	-----	0.0035
Bearing bore	0.4950	0.4956			
Shaft diameter	0.4936	0.4938			
Bearing clearance.....	0.0012	0.0019	-----	-----	0.003
Governor:					
Backlash between drive gear and driven gear	0.002	0.006			
Oil pump:					
Clearance between gears and cover, total	0.002	0.004			
Shaft diameter	0.7404	0.7410			
Bearing clearance.....	0.0010	0.0026	-----	-----	0.004
Idler Gear:					
Backlash between idler gear and crankshaft gear	0.001	0.013			
Bearing bore	1.2505	1.2515			
Bearing clearance.....	0.0020	0.0036	-----	-----	0.0065
Drive Gear:					
Backlash between drive gear and idler 0gear	0.001	0.013			
Piston Pins:					
Clearance in rod bearing	0.009	0.0019	-----	-----	0.004
Maximum clearance in piston	-----	-----	-----	-----	0.004
Piston Rings:					
Piston ring side clearance:					
Top ring	0.0030	0.0044	-----	-----	0.007
Intermediate ring	0.0025	0.0039			
Oil control ring	0.0015	0.0033			
Ring Gap (new liner and ring):					
Top ring	0.017	0.023			
Intermediate ring.....	0.018	0.024			
Oil control ring	0.013	0.023			

*Table 1-1. Engine Repair and Replacement Standards
For Engine Model D333TA--Continued*

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear or clearances
	Min	Max	Min	Max	
Rocker Arm:					
Bearing bore -	0.7260	0.7266			
Clearance between shaft and bearing	0.0010	0.006	-----	-----	0.005
Turbocharger:					
Clearance between impeller and bearing housing (shaft pushed toward impeller end)	0.018	0.022			
End clearance.....	0.004	0.006	-----	-----	0.008
Bearing diameter (id)	0.6880	0.6883			
Bearing diameter (od).....	1.0585	1.0590			
Maximum allowable bearing clearance-(satisfactory if compressor wheel and/or turbine wheel bore have not rubbed cover on housing)					
Journal diameter	0.6862	0.6855			
Housing bore diameter	1.0625	1.0630			
Thickness of thrust bearing	0.225	0.226			
Thickness of thrust rings.....	0.099	0.100			
Width of groove in sleeve-	0.128	0.130			
Side clearance in groove of sleeve with two ring seals installed side by side	0.002	0.006			
Minimum ring seal width	-----	-----	-----	-----	0.062
Maximum ring seal groove width	-----	-----	-----	-----	0.068
Valves:					
Valve face angle 29 1/4.°					
Valve seat angle 30°					
Valve width:					
Inlet.....	-----	0.076			
Exhaust.....	-----	0.078			
Valve height (top of valve to face of head with valve seated):					
Inlet -	0.082	0.128			
Exhaust.....	0.082	0.128			
Exhaust:					
Clearance (hot).....	0.025				
Clearance (cold)	0.028				
Stem clearance in bushing	0.003	0.005			
Maximum clearance with new valve	-----	-----	-----	-----	0.007
Inlet:					
Clearance (hot)	0.015				
Clearance (cold)	0.017				
Stem clearance in bushing	0.003	0.005			
Maximum clearance with new valve	-----	-----	-----	-----	0.007
Valve Lifters:					
Bore diameter	1.3125	1.3135			
Lifter diameter.....	1.3100	1.3110			
Maximum clearance.....	-----	-----	-----	-----	0.009
Valve Springs:					
Force when compressed to 21 in	53.20	58.90			
Water Pump:					
Clearance. between impeller and housing	0.005	0.015			

*Table 1-2. Engine Repair and Replacement Standards
For Engine Model 687C-18-ES*

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear	Maximum allowable clearances
	Min	Max	Min	Max		
Valves:						
Valve clearance (cold)	0.012	0.014				
Valve guide--to-stem clearance	0.001	0.003	-----	-----		0.007
Rocker arm-to-bushing clearance	0.002	0.003	-----	-----	0.006	
Rocker arm-to-pivot clearance	0.001	0.002	-----	-----	-----	0.005